Issue 32

June 2020

Utah Valley Amateur Radio Club

The UVARC Shack

Making connections

In our May 2020 online club meeting, Jeran and Noji demonstrated how to install connectors. But that wasn't all we did during this time of staying at home. The club has also been putting on multiple fox hunts each week, to give members an opportunity to find out first-hand what this is about, why it's useful, and explore yet another aspect of amateur radio.

In this issue of the *UVARC Shack*

Fox-hunting for families to help cure cabin fever.

Brass Tacks explores solar power, from the molecular to the mobile.

Way to Be for NV7V and *My Shack* for WB6KIT. *Dear Annette* tells how to give signal reports, why ham radio is a license to learn, and whether you should carry your license with you. Discussion in *Hot Tips* on how to use the NanoVNA to measure SWR. Simple *DIY* for a satellite VHF/UHF Yagi antenna. Lightning protection, HT accessories, and more,

Please send your ideas, stories, questions, gripes, and photos to ***uvarcshack@gmail.com***

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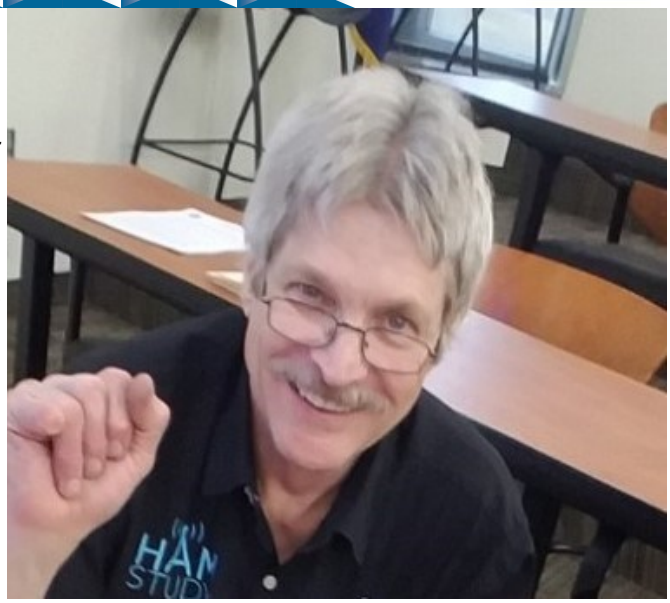
Way to be

Spotlight on our members

Steve Whitehead, NV7V



For years now, Steve Whitehead has been teaching one-day Technician classes at BYU and other places. As an accredited ***CVE*** (contact volunteer examiner, or session manager — the person authorized to organize and hold amateur radio exam sessions), Steve has also provided numerous exam opportunities in Utah County, and many of us recognize him as one of the first faces representing ham radio to us.

Due to the Pandemic, most ham radio exam sessions around the US have come to a halt, because following the VEC (volunteer examiner coordinator — the exam governing body) rules requires somewhat close contact between VEs (volunteer examiners) and the candidate during the entire exam. This made it difficult, for example, to test many candidates in the same room, in light of the fact that most facilities (government, corporate, school, medical) will no longer allow public gatherings in their rooms. Meanwhile, the list of people who wanted to take a ham radio exam kept growing.

Steve decided to put his head together with Richard Bateman (who developed the online app that presents ham radio exams), plus others, and come up with a way to hold exam sessions while following both VEC rules and CDC safety guidelines. He eventually became the author of the *drive-through exam session*, which allows a candidate to make an appointment, drive to a designated parking lot (with permission from the owner, of course), and remain in the vehicle during the entire paperwork, payment, and exam process, all while being overseen by several masked VEs.

On one hand, Steve's drive-through session takes a little longer than exam sessions normally do, because only a few candidates could be tested at the same time. But on the other hand, it made exam sessions *possible* again. This method has worked so well that other CVEs have taken notice and began copying Steve's approach, gradually allowing ham radio license candidates to once again get their licenses.

By the way, not to steal any of Steve's limelight, Richard Bateman was spotlighted in the 05-20-2020 CQ DX Hall of Fame Awards for his online tool contribution.

We salute you, Steve, for your brilliant initiative and novel approach to overcoming an enormous obstacle!

My Shack

Highlighting the shack (ham equipment and room) of a member, to give others an idea of the possibilities that might work for them

Daylon Dean, WB6KIT

Way back in the day, Daylon got his start in radio through CB (Citizens Band), even working for Muntz Radio in California, but he was a little intimidated by the PTT button, so didn't transmit much.

One day, while visiting my daughter-in-law in Orem, a friend of hers showed me his Baofeng HT, which he said he used on outings, even though he was unlicensed. Well, I took the challenge upon myself to find out how to use it legally, so I Googled and found HamStudy, studied for the exam, Googled for an exam location, and took and passed the Technician exam at BYU. I repeated that, and a month later passed the General exam there too. To this day, the young man never got his ham license, but by now, I was hooked.

My father-in-law was quite the CBer, but he was also a ham. After he passed away, his Kenwood TS-520S got passed down to me. I put up a hy-gain AV-14AVQ antenna, which kept failing on me, and eventually moved to an OCF dipole, which has worked wonderfully since. Today, you can hear me on the 6-meter Net, the Skyline Net, and our (Orem Aspen) Stake Net.

I've decided to start looking into DMR, and maybe even other digital modes. This is the most amazing hobby, with endless possibilities.

Here's my equipment list:

Yaesu FT-991A HF/VHF/UHF transceiver
Yaesu FT-891 HF / 6 m transceiver
Yaesu FT-7900R VHF/UHF transceiver
Dentron 922 amplifier
Dentron Super Tuner
MFJ MFJ-17754 40/20 dipole antenna
MFJ MFJ-17758 80/40 dipole antenna
Pockrus J-pole antenna
Tram 1481 3-element VHF/UHF collinear
Cushcraft 5-element 6-meter beam

— 73, Daylon WB6KIT

Events

Upcoming happenings

UVARC Field Day 2020

At the writing of this newsletter, Wasatch County has gone to Code Yellow, meaning UVARC is still planning to participate in ***Field Day***, Sat June 27 through Sun June 28, perhaps the largest amateur radio event of the year, now that the Hamfest is no more. Obviously, plans can change quickly, and we'll do our best to keep you informed as we get closer to the date.

Assuming all systems are go, we'll gather at the Co-Op Creek site just off Forest Road 451, near Strawberry Reservoir once again. Here's a link to the map.

UVARC will set up three main stations, and include digital, CW, and SSB, plus a GOTA (get-on-the-air) station, satellite station, and at least two VHF stations.

We'll be hosting a potluck dinner Saturday at 5 pm, with a sign-up sheet to be published later.

If you're new to HF, this might be a good chance to get on the HF air for the first time, and experience first-hand what it's like to communicate with others across the nation without going through a repeater, and hear what it sounds like. One step in long-distance emergency communication prep.

If you do Facebook, go to https://www.facebook.com/events/231678241439333/ and sign up to come, and follow our progress. *We're still in a pandemic, so under these circumstances, we leave it to your judgment, to decide whether your health and circumstances allow you to attend Field Day, more out of concern for others than for yourself.*

See you there!

Utah Valley Swapmeet 2020

The *2019 Utah Valley Swapmeet*, sponsored by the Utah Valley Amateur Radio Club, will be held on Saturday September 26 from 9 am to noon, in the Spanish Fork North Park Grand Pavilion, 1188 N 400 E in Spanish Fork, same as last year. Entry is $5 per person or $10 per family. The purpose of a swapmeet is to offer buyers and sellers an opportunity to get together and buy / sell / trade, plus the chance to rub shoulders with both new and long-lost ham friends. But this swapmeet will also provide the following:

- Demonstrations of amateur radio gear, including helping you get on the air (GOTA station)
- Information on many aspects of amateur radio, including HF, digital, APRS, SOTA, portable, and much more
- Opportunity for many ham radio clubs, social groups, and associations (76ers, Utah VHF Society, UVARC, UARC, UDXA, WDARC, ARRL, etc.) to recruit members
- Chance for service organizations (SLCOARES, UCARES, TCARES, DCARES, TERT, ERC, SAG, ARC, VEC, etc.) to invite and recruit members and inform attendees
- Radio programmers who could program your radio on the spot, depending on your radio model and where you live

The website for the Swapmeet is utahvalleyswapmeet.com. Hope to see you there!

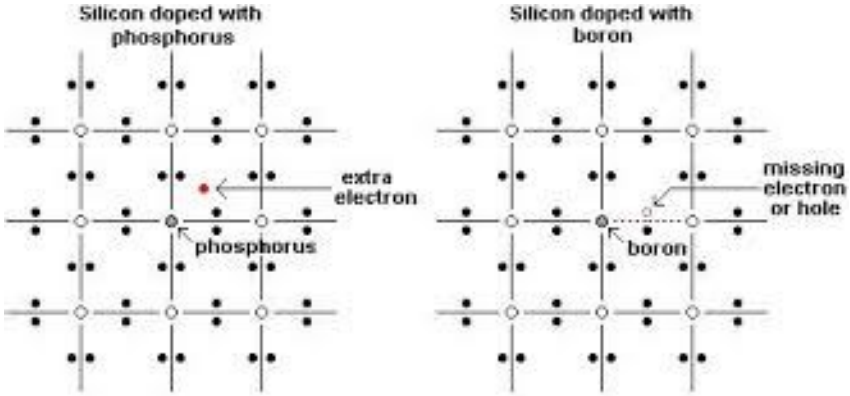
Brass Tacks

An in-depth look at a radio-related topic

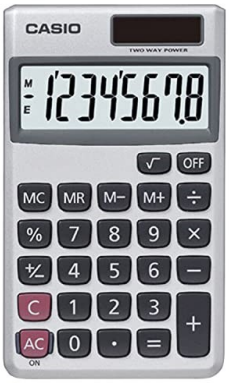
Solar power

Every day, more and more people turn to the Sun as this seemingly limitless energy source that freely shines down upon us. Whether it's by solar panels on our roofs or through a tiny film on a calculator, we're taking advantage of technology that allows us to convert *radiant energy* into *electrical energy*. Let's address exactly how that conversion takes place.

A solar cell starts out as two slices of ordinary silicon, a good insulator in its pure form, but made with an impurity mixed in, a process known as *doping*. One of the impurities is phosphorus, creating an ***n-type*** material, meaning the chemical bond between silicon and phosphorus results in an *extra electron* in the substance per phosphorus atom. The other impurity is boron, creating a ***p-type*** material, meaning the bond between silicon and boron results in a *missing electron* in the substance per boron atom.



These impurities turn the otherwise pure silicon insulators into fair conductors (called *semiconductors*), and are not all that remarkable by themselves. But bringing the two pieces of differently doped silicon in contact with each other produces an electronic arrangement such that electrons can flow through the two conductors, from the n-type side (***cathode***) through the border (called the *P-N junction*) between them, to the p-type side (***anode***), *but not in the other direction*, due to the polarized electric field created by the junction. This is known as a *semiconductor diode*.

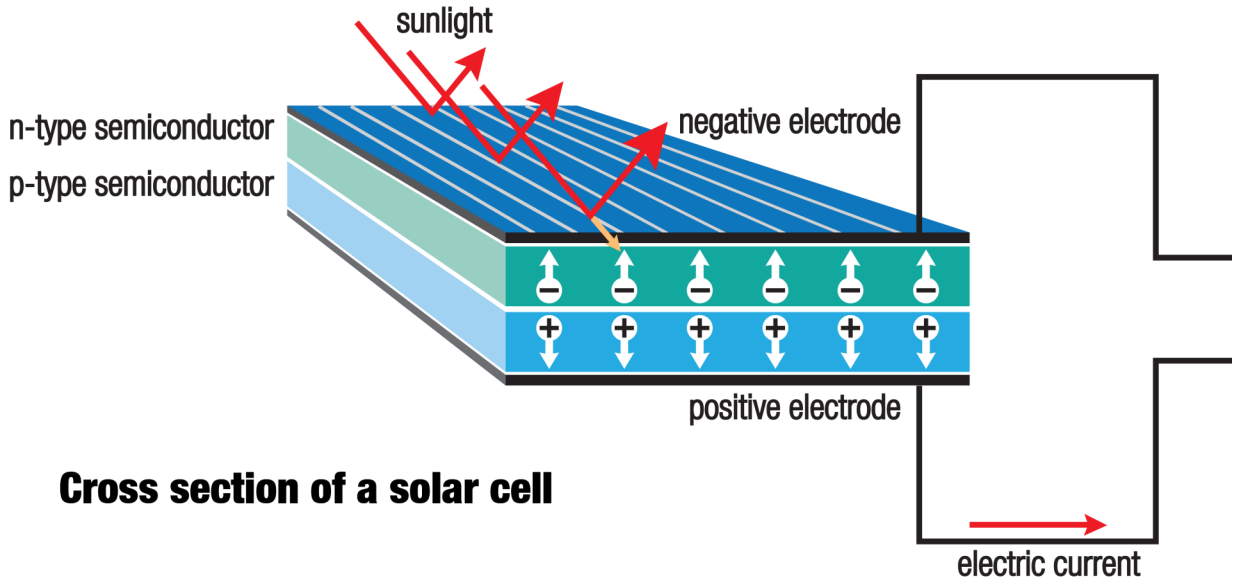


So, a solar cell is not much more than an ordinary diode, but necessarily so, to favor a current flow in one direction, like a battery. Without this diode effect, the electrons would diffuse in both directions, neutralizing the current flow. (Also, keep in mind that the direction of *current flow* is the same as that for *hole flow*, and is opposite the direction of *electron flow*.)

Brass Tacks

continued

When sunlight strikes the n-type surface, the energy of the photons can be great enough to cause an electron in the phosphorus valence band to absorb the radiant energy and jump to the conduction band and become free to move about (the sunlight knocks it loose, to allow for electron flow). Because of the electric field imposed by the potential difference across the P-N junction, the freed electron rushes toward the p-type side (and holes toward the n-type side), where it accumulates with others, and presents an external charge pressure (voltage) to its external metallic electrodes, by electrons on one and holes on the other.



Cross section of a solar cell

This is known as a *photodiode*, or a *light-absorbing diode*, and the process described is known as the ***photovoltaic effect***. If you then wire a closed resistive circuit across the electrodes of the two sides, a current will flow through the photodiode when it's exposed to sunlight. Couple several solar cells together electrically to form a ***solar panel*** or solar module. A *solar array* is a set of solar panels you might find on a building. It's important to note that, without

solar cell

solar array or panel array

Brass Tacks

continued

the circuit to form an electrical path between the anode and cathode, there's no place for the electrons to go, and the solar cell will simply receive the light without performing any of the conversion.

Efficiency

Capturing and converting more of the Sun's rays is an ongoing development struggle, and where much of the current research is focused. One problem is the unused light that's reflected off the solar cell surface. Another is the heat generated by light absorption. It turns out that some of the heat actually aids the conversion process, but the majority is wasted. So, just how much radiant energy is converted to electrical energy? Depends on the solar cell technology.

At the time of this writing, about 10% of the solar market uses ***thin film*** solar cells, which are less than 20% efficient, meaning for every five buckets of sunlight poured onto a thin film solar cell, under one bucket of electricity will be produced. (I forget right off what the conversion factor is, from buckets to kWh, but I digress.) Over 50% of the current market uses ***polycrystalline*** solar cells, which are about 20% efficient. About 33% of the current market uses ***monocrystalline*** cells, which are of slightly newer technology, and about 23% efficient.

Power management

One of the primary problems encountered when using solar panels is the wide range in voltage presented by a solar cell, due primarily to the proportion of sunlight exposure. Obviously, your panel can produce more power when it's exposed to direct, bright sunlight, than during cloudy or dimly lit hours. A device called a ***charge controller*** is essential to almost any solar-powered solution, and can provide a steady voltage over a wide range of available light. More generally, the purpose of a charge controller is to *manage power* in a solar setup.

Unlike with a solar-powered calculator, most solar solutions involve the *storage* of energy, to allow a supplied device to continue running, even after dark. For this, you'll need a ***battery***, and one that can be charged daily and withstand a fairly large amount of energy depletion (more on this later). In spite of the battery variety available for solar power, a charge controller can perform many necessary functions involved with energy storage.

A charge controller should be able to a) charge a battery while running a device, b) charge a battery while running no device, c) sense the amount of stored energy currently in a battery and adjust its supply to the battery as needed, and d) prevent depletion of the battery by the solar cells during dimly lit moments. In general, there are two kinds of solar charge controllers on the market today that perform these tasks: PWM (pulse-width modulation) controllers and MPPT (maximum power point tracking) controllers.

Brass Tacks

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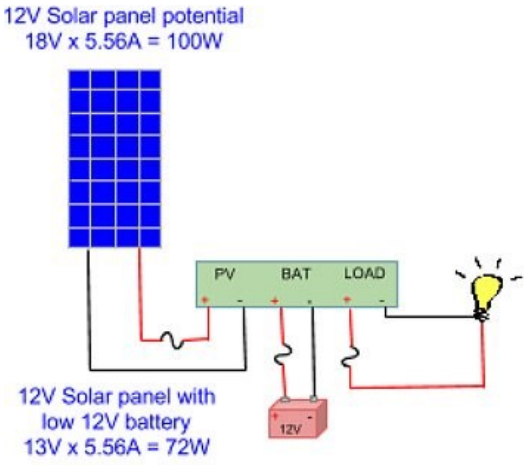
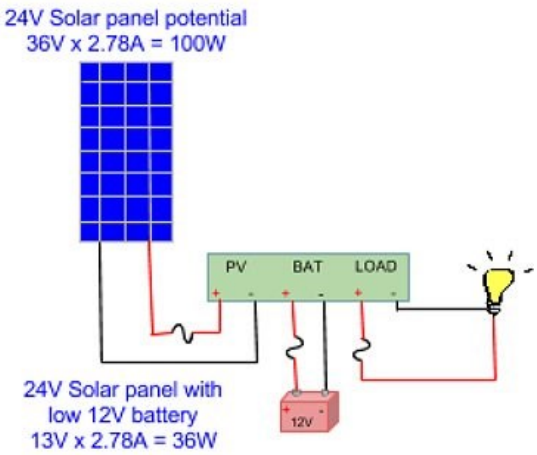


12V Solar Panel with PWM charge controller charging a low 12V battery

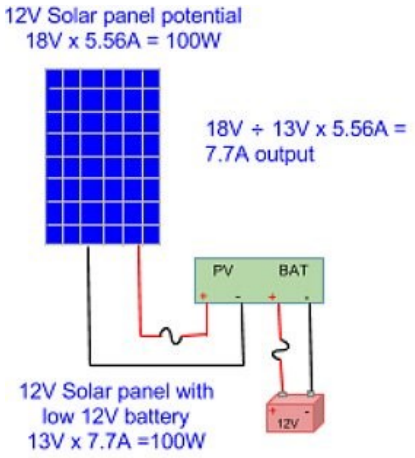
28% loss



24V solar panel with PWM charge controller charging a low 12V battery

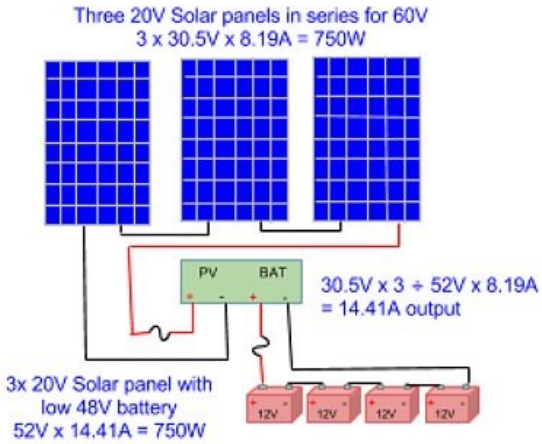
64% loss

PWM charge controllers are typically lower in cost than MPPT charge controllers, but they tend to incur heavy power losses when the solar panel output does not match the nominal battery voltage. MPPT charge controllers are typically much more expensive than PWM charge controllers, but incur very little power loss, whether or not the panel output matches the battery voltage, and can often make up for the cost difference in power savings. If you can afford one, I highly recommend using an MPPT-type charge controller for your solar needs.



12V Solar Panel with MPPT charge controller charging a low 12V battery

Virtually no loss



Three 20V Solar Panels in series with MPPT charge controller charging a low 48V battery

Virtually no loss

Brass Tacks

continued

Energy storage

Once you've successfully converted and controlled all that free solar energy, you'll need to store it, to ensure that energy will be available to you after dark. As mentioned, this storage is normally available in the form of a battery, but not just any battery. Of course, the battery intended for solar energy storage needs to be *rechargeable*, but also ***deep-cycle***, meaning it should be able to handle a large depletion of its stored energy without damage to the battery.

There are other battery factors to consider, such as nominal (the named) voltage, capacity (number of Ah), content (lead-acid, lithium, AGM, etc.), depth-of-discharge, and more, but we'll save our exploration into these different parameters for another article. Meanwhile, let's agree on a few battery semantics, to make sure you and I are speaking the same language.

First, the word ***charge*** is a little confusing. When we use it as a verb, as in, "I want to charge my battery," or "My battery is fully charged," that's appropriate, because it means ***store energy in***, or in other words, *energize*. But using it as a noun is where it gets confusing, as in "My battery stores charge," or "The controller sends charge to my battery." This is because, as long as your battery doesn't gain or lose any chemicals, *it will always contain the same amount of charge, whether it's fully energized or completely dead*.

Second, batteries work by chemical reaction, so that one chemical reacts with a metal (called the ***anode***, or negative "**–**" terminal), and *produces* electrons as a reaction by-product. If there's no place for the electrons to go, the reaction can only take place up to a point of equilibrium. Meanwhile, another chemical reacts with another metal (called the ***cathode***, or positive "**+**" terminal), and *requires* electrons for its reaction to complete. If nothing provides electrons to complete the reaction, the reaction cannot take place there, until the electrons are provided.

Third, if we now compare the amount of potential (possible) electron stream *available* at the anode, with the amount of potential electron stream *needed* at the cathode, we call the difference between the two potentials ***voltage***. Indeed, it's more technically accurate for us to say that the battery stores *potential energy*, rather than saying that it stores *electrical energy*. However, in the interest of brevity, I'll just say that the battery ***stores energy***, and you'll know what I mean. (Also, I'll not attempt to distinguish between a battery and a ***cell*** here.)

Using the battery

If we provide a pathway (wire, circuit, etc.) for the electrons in the anode reaction to flow to the cathode reaction, both reactions can readily take place, and we now have ***direct current*** (DC) flow though the pathway, from the cathode side, through the pathway, and into the anode side. If the battery chemical reactions are reversible, we call that a ***rechargeable battery***; if they are not reversible, it's a one-life, non-rechargeable battery, to be discarded after most of the chemicals have reacted to present an acceptable voltage level.

Brass Tacks

continued

Now, let's replace the pathway with our solar cell, the subject of this article. If we connect the solar cell anode with the rechargeable battery anode (and therefore, cathode to cathode), and the potential (voltage) presented by the solar cell is greater than that of the battery, then expose the solar cell to sunlight, current will flow out the cathode of the solar cell and into the cathode of the battery, reversing the chemical reactions and effectively ***recharging*** the battery. But that flow needs to be carefully controlled; hence, the need for the charge controller.

Calculating solar power needs

Knowing just how much solar power you'll need will require some fair estimation, and might even include some predictions of your future needs. On one hand, you can power your entire home with a large solar array and a battery bank to match. On the other hand, since this newsletter is geared toward amateur radio, let's concentrate on that one aspect. To illustrate how to calculate your needs, I'll present two radio-related situations, mobile and portable HF, including an inefficient inverter for a laptop.

Electrical needs common to both

- laptop (Chromebook charger and inverter = 6.6 A » 6.6 Ah)
- cell phone charger (12 V to USB = 3 A » 3 Ah)
- lighting (PWRbrite LED Light Strip = 0.2 A » 0.2 Ah)

Common hourly energy draw = 9.8 Ah

Mobile solar solution

- mobile radio (Yaesu FT-8800R = 9 A, but at 50% duty cycle » 4.5 Ah)

Total mobile hourly energy draw = 9.8 Ah + 4.5 Ah = **14.3 Ah**

Portable HF solar solution

- portable HF radio (Yaesu FT-891 = 23 A, but at 50% duty cycle » 11.5 Ah)
- tuner (LDG AT-100Pro II = 0.5 A » 0.5 Ah)

Total portable HF hourly energy draw = 9.8 Ah + 11.5 Ah + 0.5 Ah = **21.8 Ah**

21.8 Ah x 12 V = 261.6 Wh, which is the amount of energy you'll need, to run your portable HF station. Assuming an 80% efficient solar solution, you'll need a 261.6 Wh / 0.80 = 327 W solar panel charging your battery for an hour, or a 100 W panel for about 3½ hours. A 100 Ah deep-cycle battery will easily take care of these needs. If you talk less on the air (say, 25% duty cycle), you can lower those amounts to 2½ hours with the same panel into a 50 Ah battery.

Summary

The discussion about solar power is not a trivial one, and involves some understanding of not only how to convert radiant energy into electrical energy, but how to control it and store it. Similarly, figuring out just what it's going to take, to supply your solar needs, is also a little involved, but practical if you keep inefficiencies in mind. One final word about charge controllers: some of them tend to generate radio noise ("hash"), so keep that in mind too.

Noji Ratzlaff, KNØJI (kn0ji@arrl.net)

Dear Annette

What's on your mind? Serious, humorous, technical, and thoughtful answers to your deepest, (mostly) ham-related questions.

Dear Annette:

During contests, it seems that people almost always give signal reports of 5-9, no matter how rough the copy really is. But there are times when I'm on HF and I'd like to give an accurate signal report for those who ask for one. If they come in naturally at 3-3, and I turn on my DSP, they might sound 5-6. And if I pop on the attenuator or lower my RF gain, I can get them at 4-9. So, which is the correct signal report to give?

Brad in Payson

Dear Brad:

The RST (readability-strength-tone) system was originally created as a standardized way of reporting the perceived quality of a CW (Morse code) *signal*. An S-meter (signal strength meter) on a radio receiver was calibrated such that each whole number graduation (between S5 and S6, for example) represented a 6 dB difference in received signal strength. Today, due to many receiver enhancements, we can greatly improve the perceived *audio* of the signal that we hear. The report is now up to your subjective ear, because *you're reporting on the readability and strength of the audio, as you hear it*. This means the most accurate report you can give is one you've determined by only listening, not reading off some meter. So, if the other person comes in at 5-9 only after you've applied a filter, then you should report 5-9.

Dear Annette:

I know that people say there's no such thing as a dumb question, but sometimes I get tired of hearing people ask about things they should have learned before taking the test. Why do we even have tests for ham radio licenses if people aren't willing to learn the material?

Jackson in Orem

Dear Jackson:

Great question, and I'm happy to answer it! The amateur radio license is a unique and special permit to do things outside the reach of most other communication services, things such as experimentation and equipment modification. As such, it's a *license to learn*. The amateur radio exam is designed to test ***our ability to handle a level of responsibility***, not how much we know. And if you really do get tired of hearing others ask basic questions, there are many other mentors who will happily reply, and there's no shame in allowing them to answer instead.

Dear Annette:

Is it true that I need to keep my ham radio license with me when I go places where I want to use my radio? When I signed up for ARES, they told me that I need to keep it with me.

Martin in Riverton

Dear Martin:

There was a time when the FCC asked radio amateurs to accompany their stations with a copy of their licenses and a few other things. Today, we're not required to keep our license with us (unless you're using amateur radio frequencies to control a space station or model airplane), but we are required to present the FCC with a copy of our license if they request it, for whatever reason. Then again, it might be handy when an official asks you to produce it, or even for showing off a bit. As for ARES asking you to keep a copy of your license with you, I believe that was more of a guideline than an actual rule.

Got a question for Dear Annette*? Email it to* ***uvarcshack@gmail.com*** *and include your town name. Sorry, no guarantees.*

The Amateur in You, Part 1

What have you been pondering?

Handheld radio accessories

Whether you plan to use your radio for a family road trip or a local emergency, chances are, you'll be using an HT (handheld transceiver) at one time or another. On one hand, these little units can pack a real punch when you need them; on the other hand, their miniature and portable nature often causes us to forget how limited they can be without extra added gear they might need.

Gear list

Let's list some of the accessories that can help your HT, or help you when operating your HT. Since this training is meant to complement a *handheld* radio, I'm going to assume that you've already got one, so these things are *in addition to* your HT. Also, these are only suggestions, so some of them might not be as applicable to you, as for another ham:

- A better antenna than the one that came with your HT, such as
  - ◊ A Signal Stick
  - ◊ A whip antenna
  - ◊ A telescopic whip
  - ◊ A Slim Jim antenna
  - ◊ A roll-up J-pole antenna
  - ◊ A tactical blade antenna
- An external microphone or lapel mic
- An earpiece or ear bud
- Additional power sources, such as
  - ◊ An alkaline sled, which is an empty case for alkaline batteries
  - ◊ An extra rechargeable battery, like Li-ion, NiMH, LiFePO4, and more
  - ◊ A charger, if you believe you'll be near an AC outlet, or a *battery eliminator*, if you're in a vehicle
  - ◊ A portable solar panel and charge controller, with appropriate cabling and DC connectors
- A programming cable (and therefore, maybe even your laptop)
- A belt clip (for the radio)
- A lapel clip (for the microphone)
- A chest harness or gear organizer
- Spares for any of the above

Unrelated essentials

And here are a few things not related to ham radio, that might help while using your HT:

- A flashlight or desk light or headlamp
- Pen and paper, permanent marker
- A bottle of water
- An umbrella, for either rain or sun

Finally, do you need to rush out and purchase all of these things this very week? Of course not. *You* decide which accessories make the most sense for you to use, then gradually build up your equipment arsenal as you have the means to do so. Also, with experience, you'll find that your equipment wish list will mature, allowing you to pick the *right* gear for your circumstances, and maybe others that aren't listed here.

The Amateur in You, Part 2

What have you been pondering?

Basic lightning protection

As most realize, there aren't many parts of our country that are immune to lightning strikes. As a result, people who have antennas installed on their roof tops wonder whether they should do something to prevent damage to their equipment from the effects of lightning. On one hand, some hams run to their radios when a storm approaches, and disconnect their coax. On the other hand, if they're away from home, that's not always possible or practical. Should you simply keep your coax disconnected, until you need to get on the air?

Repeater station

If you visit a repeater site, you'll likely find a ham radio a lot like your own, located in a small building. Attached to the radio is a length of coax, that connects it to an antenna, which is typically installed up on a tower, whose base is just feet from the building. Because the tower is on top of a mountain, it gets struck by lightning numerous times throughout the year. So, when a lightning storm approaches the mountain, do you think there's somebody who races up the mountain each time, and disconnects all of the repeater's coaxial cables?

In fact, nobody flies up to the repeater each time it starts raining, that we know of. Instead, a repeater is connected by coax to an antenna and tower that's properly grounded. This *proper grounding* diverts most of the lightning energy to ground, protecting the repeater and all of its associated gear. The same grounding methods can be applied to your home station, to protect it from lightning damage, but you really don't need to, or even want to. You don't need to install a commercial-grade grounding system, because chances are, your home will never receive a direct lightning strike. And you don't want to, because the cost of doing so is very high, beyond the reach of the common folk.

What are the odds?

First, it's much more likely that lightning will strike a few blocks away from you, than right at your house. Is it possible for it to strike your house? Sure it is, but highly unlikely, because your house doesn't offer the cloud much reason to complete an electrical path. Yes, it would be nice to protect your home and all your gear from a direct lightning strike, but in reality what you're trying to protect it from is either a *nearby strike* or *static buildup*, which are much more likely.

Bare 4 AWG ground wire clamped to the J-pole mast, opposite from the side of the LMR-400 coax

The Amateur in You, Part 2

Basic lightning protection, continued

Second, when lightning does strike nearby, or if static builds up because of wind or blowing dust or moving clouds, that static can collect. And once enough charge collects on your antenna, that electrical imbalance needs to find a path to ground, and often that path is through your equipment. The object, then, is to give that static buildup a place to go before it reaches that critical level.

Minimal protection setup

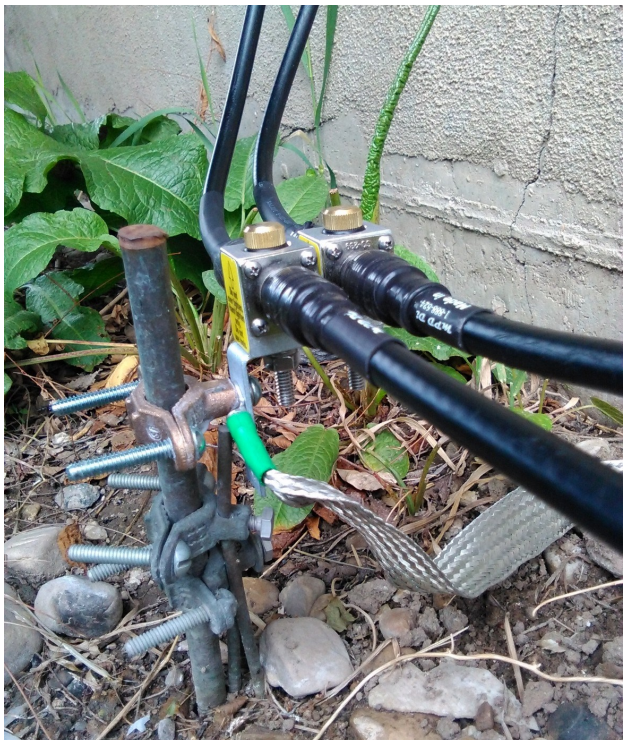
Here are some practical and inexpensive things you can do, to apply some basic lightning and static protection into your antenna system:

- Drive two eight-foot-long half-inch ground rods into the dirt about a foot away from your house, one just below your antenna, and the other about half-way around your house to the electrical service box
- Connect a length of 4 gauge or 6 gauge bare copper wire between the two ground rods, then connect another length of 4 or 6 gauge bare copper wire from the electrical service box to the ground rod closest to it
- Connect a length of 4 or 6 gauge bare copper wire from the base of the antenna or its mast (if the ground part of the antenna is electrically connected to the mast) to the ground rod below it

At this point, your grounding system should protect your equipment adequately if your antenna is a *J-pole*, because the ground on a J-pole is typically higher in elevation than its radiating element. If your antenna is any other type, its radiating element will likely be higher in elevation than the ground portion, leaving the radiating side with little or no connection to ground. If or when you're ready to ground the radiating portion of your antenna, do this:

- Install a *lightning arrester* onto the ground rod below your antenna
- Connect a length of coax from your antenna to the lightning arrester, then another length of coax from the other side of the lightning arrester to your radio

There are more things you can do, towards making your antenna system completely lightning-proof, but that's not the purpose of this brief overview. If you really want to install a commercial-grade site, and you have the means to do so, it should be able to weather just about any storm. The basic installation described here, however, should provide your equipment with some *adequate* protection from most typical storms and static charge buildup at your home.



Ground rod connection, with each coax going through a grounded lightning arrester, plus a 4 AWG ground wire for the antenna

Hot Tips

Good info for the new ham, and old stuff to refresh your memory

Using a NanoVNA to Test SWR

Some who are truly serious about measuring passive ham radio stuff, such as coax impedance, antenna SWR, and continuity, eventually purchase an expensive piece of equipment called a VNA (vector network analyzer). But their multi-thousand-dollar price tags tend to keep them out of the reach of mere mortals.

That is, until the advent of the *NanoVNA*, a pocket-sized version of a VNA that supposedly has many of the same functions, but for under $70. Still, many hams prefer the security of using an actual antenna analyzer when they only want to measure SWR and impedances. But even those devices (RigExpert AA-230 ZOOM and MFJ MFJ-269D, for example) cost upwards of $350 each. That all changed, however, when *QST* (May 2020, p. 39—43) reviewed the device and declared it a serious and worthy test instrument.

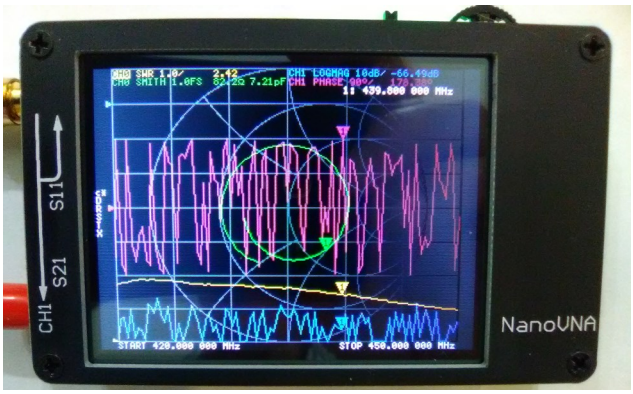
Many do-it-yourself-er hams soon rushed out and purchased one of these little devices, but they quickly discovered that using a NanoVNA is not all that straightforward. I'm hoping this quick-start guide will help, if you've purchased one too. These instructions apply to the original NanoVNA, and not the —F or —H versions. Also, they'll be for the device screen, not the PC user interface screen software. Finally, I'm going to skip the calibration steps, to simplify things, although calibration is a good idea.

Step 1 — Set the frequency range

Power up the NanoVNA using the slide switch
Press the rocker control to display the menu
Tap **STIMULUS**, then tap **START**
Tap the blank space in the lower right corner
Tap 4-2-0-M (for 420 MHz)
Press the rocker control to display the menu
Tap **STOP**, then tap the blank space again
Tap 4-5-0-M (for 450 MHz)

Step 2 — Display the SWR

Attach your antenna through an appropriate adapter to the ***TX*** connector, which is SMA-Female, and leave the ***RX*** connector empty
Press **DISPLAY**, then **FORMAT**, then **SWR**
The NanoVNA will now display the SWR for the entire 70 cm band in yellow (curves and lettering). At this point, to display the SWR at a particular frequency, toggle the rocker control either way, to move the yellow marker to the desired frequency, which shows up in white in the upper right of the display. Try and ignore the green, purple, and blue lines. *Voila!*



SWR (yellow) is 1.0 / 2.42 at 439.800 MHz (white)

DIY

Worthwhile projects you can build on your own

Dual-band satellite Yagi antenna

Many hams get into the hobby of amateur radio, and discover that some satellites have amateur radio repeaters on them, and that a person with even a Technician license can communicate with them. Using an HT (handheld transceiver). But, they eventually discover that making that attempt with a whip, or even worse, a stock, antenna, might allow you to hear the satellite's signal, but might not allow your signal to reach the satellite.

It turns out that, for very little cost, you can make an antenna that can help you effectively use a satellite to communicate with another ham on a different part of the planet. But there's a catch. Satellites contain essentially *cross-band repeaters*, because the hardware to support a same-band repeater is way too heavy. And cross-banding means you need to transmit on one frequency band and receive on another. In this case, the two bands (V/U mode) are 2 meters (145.850 MHz to the SO-50 satellite) and 70 cm (436.795 MHz from the same satellite).

You'll likely enjoy this antenna (patterned after one by KGØZZ), because it's a great directional performer. Let's go ahead and build the antenna, then explain how to use it another day.

Parts list

BNC male connector

One 1¼″ x 60 ″ fiberboard prefinished moulding
Eleven regular heavy (2.4 mm or 10 AWG) steel coat hangers
Two #6-32 x 1″ zinc round head machine screws
Two #6-32 zinc nuts
Eleven #6 zinc flat washers
Eleven #6 zinc lock washers
Nine #6-32 x ¾″ zinc round head machine screws
Nine #6-32 x ¼″ tee nuts
Eleven feet RG-8X coaxial cable
Two 18 AWG ring terminals for #6 stud
One BNC male for RG-8X crimp connector
Four 1″ pieces of ¼″ heat shrink tubing
22 3/32″ silicone end caps

Cut the antenna elements

Straighten and cut four coat hangers to the following lengths:

41″ 19″ 19″ 36 5/8″ 36 ½″

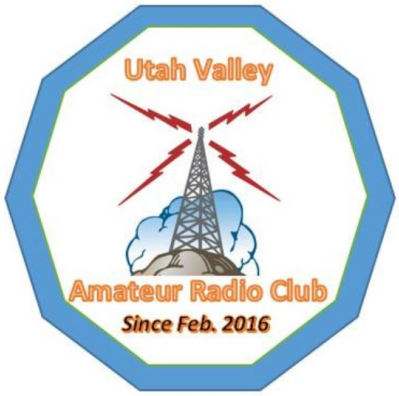
Cut the bottoms off seven more coat hangers to the following lengths:

14 ¾″ 7 ½″ 7 ½″ 12 5/8″ 12 ½″ 12 3/8″ 12 ¼″ 12 1/8″

The two 19″ and two 7 ½″ rods will be the driven elements. Sand the enamel off ¾″ each of them, then curl (with a pair of needle nose) the sanded ends into hooks that fit around a #6 screw, such that their lengths end up as the following:

18 5/8″ 18 5/8″ 7 1/8″ 7 1/8″

Then, set these rods aside.



DIY, continued

Dual-band satellite Yagi antenna

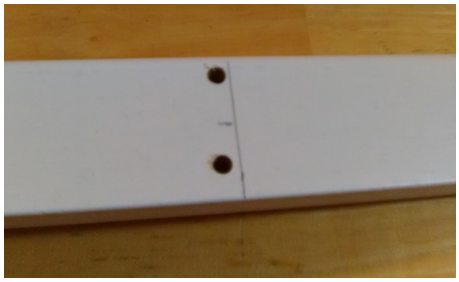
Drill out the boom

Identify one end of the fiberboard as the ***front end***, which will point toward the satellite, and the other end the ***handle end***. (You can use a furring strip instead of fiberboard, but I like fiber because of its resistance to splitting and splintering, and how nicely it cuts.) From the front end, measure and drill ¼″ holes along the center of the boom at the following distances from the front end, to insert the tee nuts:

1 7/8″, 2 ½″, 7 1/8″, 12 ¼″, 14 7/8″, 17 1/8″, 22 1/8″, 32 1/8″, 39 ½″

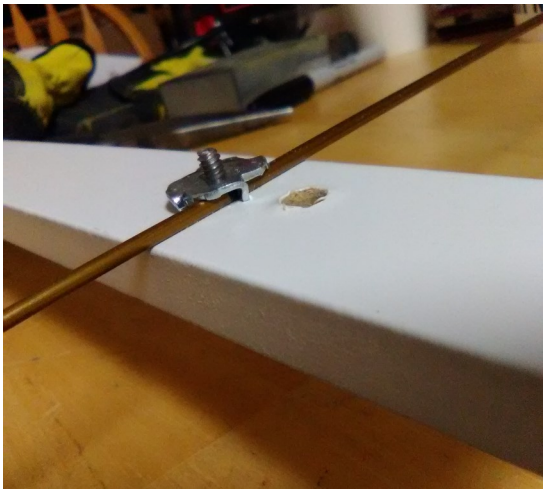
Also, drill two more 1/8″ holes ¾″ apart at 27 1/8″ from the front end.

Attach the elements

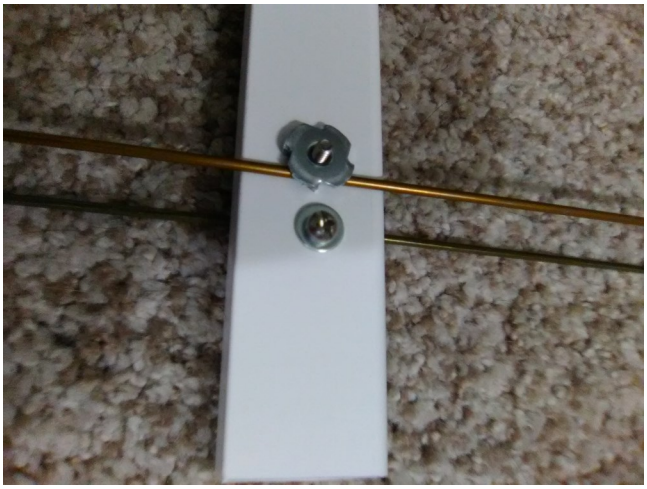


1/8″ holes ¾″ apart

Mark the center of the 36 ½″ element, and attach it to one side of the fiberboard through the 2 ½″ hole by a #6-32 x ¾″ round head machine screw through a lock washer and flat washer on one side, and tee nut over the rod on the other, with the rod through the tee nut closer to the front end. Mark the center of the 12 1/8″ element, and attach it to the other side of the fiberboard through the 1 7/8″ hole by another machine screw and tee nut set, but with the rod through the tee nut closer to the handle end of the tee nut. This is the only element whose rod goes through the handle end of the tee nut; the remaining rods go through the front ends of their tee nuts.



tee nut and rod initial assembly

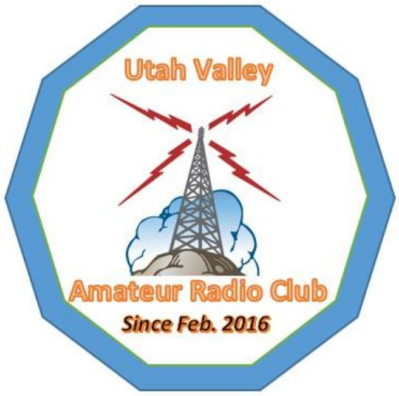


front end final assembly

Attach the 12 ¼″, 12 3/8″, 12 ½″, 12 5/8″, 14¾″ elements to the 7 1/8″, 12 ¼″, 17 1/8″, 22 1/8″, and 32 1/8″ holes, respectively, with the rods inserted into the front ends of the tee nuts, on the 70-cm side of the boom. Attach the 36 5/8″ and 41″ elements to the 14 7/8″and 39 ½″ holes, respectively, on the 2-meter side of the boom.

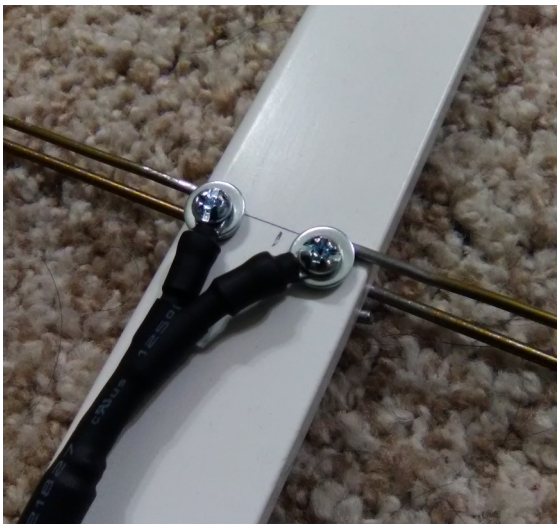
DIY, continued

Dual-band satellite Yagi antenna



Assemble the coaxial cable and the driven elements

Attach a BNC male connector to one end of the RG-8X coaxial cable, then strip and terminate the other end in #6 ring terminals. Assemble each driven element side by slipping a #6-32 x 1″ machine screw through one of the ring terminals, through a flat washer, through one of the 18 5/8″ elements, through the boom on the 2-meter side, through one of the 7 1/8″ elements on the 70-cm side, through another flat washer, through a lock washer, and through a #6-32 nut.

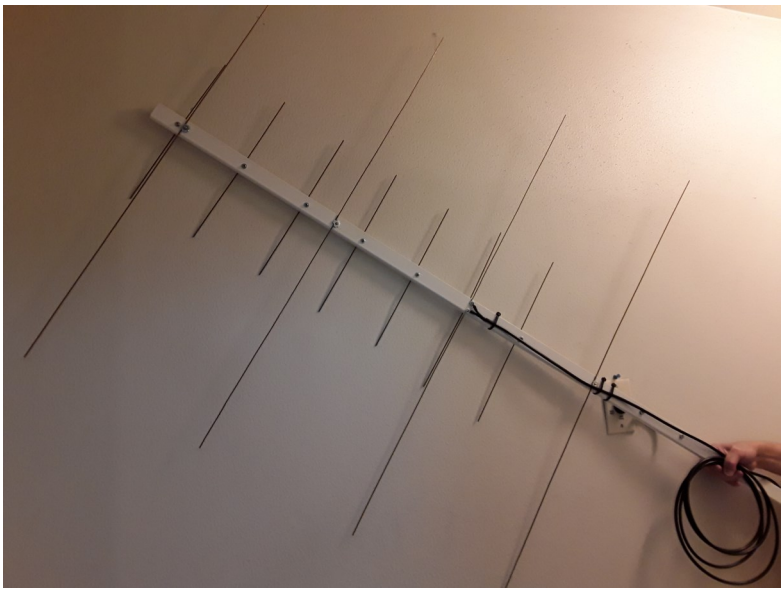


Finally, place three zip ties around the coax and boom, to keep the coax from wandering near the elements. If you want, you can do what I did, and install a small handle, to slip my hand into while I'm holding the antenna in one hand.

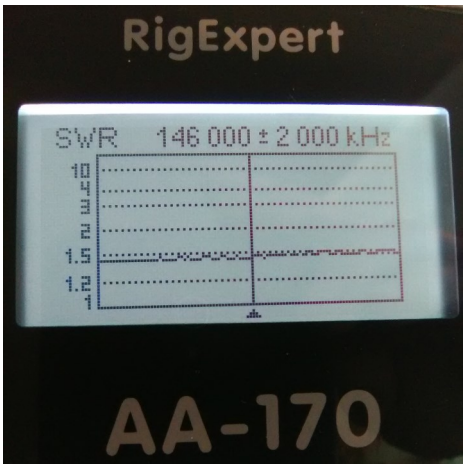
Testing it

It's a little difficult to demonstrate in this newsletter how the satellite contacts sounded like, so I'll just show you my analyzer reading instead. Since I'm transmitting on the 2-meter band, this seems to be the important band to display. As you can see, the SWR is around 1.5:1 across the band. Not bad for homebrew and no matching.

Noji Ratzlaff, KNØJI (kn0ji@arrl.net)



The finished product



1.5:1 SWR across the band

Living in the Past

Historical perspective

The first ham

In 1901, after hearing about Guglielmo Marconi's amazing feat of sending the letter "S" over the Atlantic without wires, a young boy by the name of Irving was intrigued. Barely 11 years old, Irving begged his parents to take him to attend a lecture Marconi was soon planning in Newfoundland. Accompanied by their minister, they relented and took the trip.

Marconi, who was addressing a hall of engineers and scientists, took special note of the young boy among this college of wizards, and was impressed enough to give the young lad parts (coherer and tapper) to take home and assemble into a receiver. Irving did so, even though there was no transmitter to hear, but he knew it worked, because it detected the doorbells ringing up and down his street.

Irving soon built a spark-gap transmitter, and became so proficient at wireless communication, that each of several ships offered him a job as its wireless operator, even as a high school student. In 1912, the US government established wireless licensing rules, and required all wireless operators to become licensed. When Irving heard about the new rules, he rushed down to the Brooklyn Navy Shipyard, took and passed the exam, and became the first licensed wireless operator. And being a non-professional operator, he also became the first licensed radio amateur in the US, and many claim, the world.

Once licensing and call sign rules evolved and became more established, **Irving Vermilya** became W1ZE, and had made numerous friends through his hobby. Irving served in the Navy during World War I, and after returning, helped start up several broadcast radio stations, some of which are the first in the US.

And speaking of firsts, Irving was one of the first to mentor a female amateur (Eunice Randall, who almost always beat Irving in code speed contests), one of the first to install a ham radio in his vehicle, the first to set up a police radio station, and the first

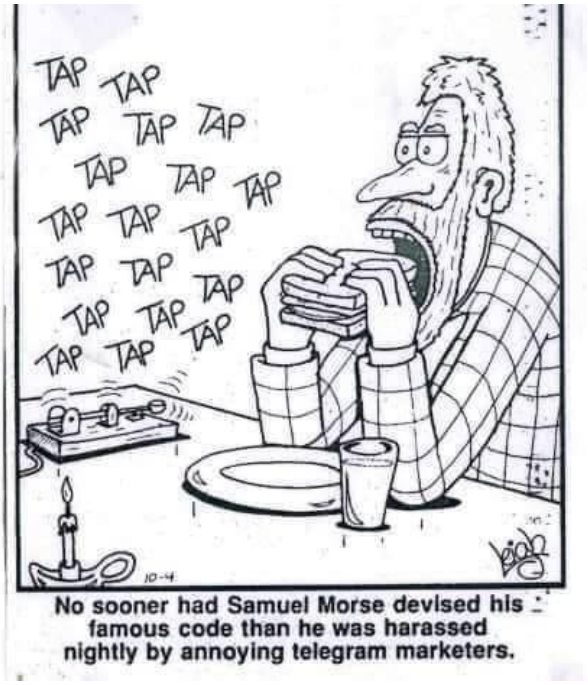
American to obtain a Canadian radio operating permit.

Shortly after his wife passed in 1964, Irving also passed away. Many from long ago remember how passionately Irving incorporated community involvement into amateur radio, and to this day, his multi-dimensional legacy lives on, as one who envisioned and then embodied the benefit of ham radio in so many ways.

Side of Bacon

A little ham humor

I'LL TAKE A SINCERE-TYPE HAM TO THOSE SQUARES ANY DAY! NOW, PLEASE, DON'T JAM MY HF BAND!
REALLY, DEAR... CAN'T YOU AT LEAST TRY BEING LIKE OTHER GIRLS?



No sooner had Samuel Morse devised his famous code than he was harassed nightly by annoying telegram marketers.

Is a "circuit judge" like the "ham police" ?

For Your Insight

Information you could use

Club meeting format

Here's the usual agenda for club meetings, at the Orem City Council Chamber Room, 56 N State St:

Talk-in frequency on the club repeaters

6:30 pm : Eyeball QSO

socialize / put faces with call signs

radio programmers available to help you

6:45 pm : Call the meeting to order

meeting lineup (agenda)

announcements / nets / awards / calendar

7:00 pm : Discussion / breakout session

discussions typically involve everybody

breakouts split into separate groups

7:45 pm : Door prizes

7:55 pm : Dismiss and disassemble

8:00 pm : *Club QSY* to a local eatery

Something you'd like to see at the meetings?

Monthly meeting help

We're grateful for the volunteers who help with various tasks that make our club night just that much more friendly and useful to everybody. Monthly, we need help with

programming radios (thanks, Loren / Ralph / Mickey!)

taking photos or videos during the meeting

operating the talk-in radio

setting up tables and chairs (thanks, Heath!)

Lynx

Websites for your education and leisure

Training items and topics for nets

Ham Radio Nets

Radio programming

76ers Group and UVARC Group pages

Utah Ham Radio Exam Schedule

Send your input to ***uvarcshack@gmail.com***

Questions of the Month

Test your knowledge (answers next page)

G4B12 : What problem can occur when making measurements on an antenna system with an antenna analyzer?

A. Permanent damage to the analyzer may occur if it is operated into a high SWR
B. Strong signals from nearby transmitters can affect the accuracy of measurements
C. The analyzer can be damaged if measurements outside the ham bands are attempted
D. Connecting the analyzer to an antenna can cause it to absorb harmonics

E7EØ4 : What is one way a single-sideband phone signal can be generated?

A. By using a balanced modulator followed by a filter
B. By using a reactance modulator followed by a mixer
C. By using a loop modulator followed by a mixer
D. By driving a product detector with a DSB signal

Calendar

What's happening
(times are Mountain Time)

Utah County Ham Exam Sessions

BYU J. Reuben Clark Law School building

Sign up at HamStudy.org/sessions/nv7v

Wed June 17, 7:00 to 8:45 pm — maybe
Wed July 15, 7:00 to 8:45 pm
Wed August 19, 7:00 to 8:45 pm
Wed September 16, 7:00 to 8:45 pm
Sat September 19, 2:30 to 5:00 pm
Wed October 21, 7:00 to 8:45 pm
Sat October 24, 2:30 to 5:00 pm
Wed November 18, 7:00 to 8:45 pm

Provo One-day Technician Courses*

Third Saturday Monthly at 8:00 am
BYU Law School Bldg, First Floor
* *except May, June, July, and August*

2020 Orem Ham Radio Courses

General : Tue 21, 28 Jul, 04, 11 Aug
Technician : Tue 22, 29 Sep, 06, 13 Oct

Club Meeting Calendar (6:30 pm)

Orem Council Chambers, 56 N State St

June 4	July 2
August 6	September 3
October 1	November 5
December 3*	January 7
February 4	March 4

* *Actually a potluck at 25 N Main St, Lindon*

Regular Nets

Jackson Hole Net, Mon 8:00 pm, 146.76
UVARC Ladies' Net, Tue 7:00 pm, 146.78
DMR Utah Net, Wed 6:00 pm, TG 3149, CC 1
UARC 76'ers, Wed 7:00 pm, 146.76
UVARC New Ham Net, Thu 7:00 pm, 146.78
CERT Net, 2nd & 4th Thu 8:00 pm, 146.78
Utah County 6 meters, Fri 8:00 pm, 50.14
Sultans of Simplex, Sat 7:00 pm, 447.825
Family History Net, Sat 8:00 pm, 146.78
UVARC Family Net, Sun 3:30 pm, 146.78
See a larger list of nets at noji.com/nets

Upcoming Contests

Kentucky QSO Party
8 am to 8 pm Sat June 6
ARRL June VHF Contest
Noon June 13 to 9 pm Sun June 14
ARRL Kids Day
Noon to 6 pm Sat June 20
ARRL Field Day
Noon Sat June 27 to noon Sun June 28
See a larger list at contestcalendar.com

Answers to the Questions of the Month

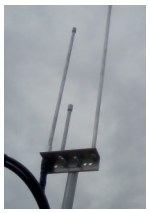
G4B12 : **B** (Strong signals from nearby transmitters can affect the accuracy of measurements)

E7EØ4 : **A** (By using a balanced modulator followed by a filter)

Vendors

For your convenience

Pockrus Joystick J-pole



$25, open-stub aluminum half-wave, dual-band J-pole antenna

$35, 6-meter dipole, $20 for the 220 MHz (1.25 m) antenna

by Carl Pockrus, WE7OMG (email myjpoles@gmail.com to purchase)

Half-wave performance, solid construction, weather-proof, low wind-load

Probably the best-performing outdoor antenna you can get for the price

Super-Elastic Signal Stick

$20, vertical quarter-wave flexible antenna

by Richard Bateman, KD7BBC, of *SignalStuff* (and maker of *HamStudy*)

Super-performing antenna for your HT (handheld transceiver)

Visit SignalStuff and select SMA-Male, SMA-Female, or BNC

Ham Radio Podcasts v1.50

Ham Radio Podcasts

by Trevor Holyoak, AG7GX (email android@holyoak.com)

Stream podcasts (such as *100 Watts and a Wire*, *Amateur Radio Newsline*, *ARRL Audio News*, etc.) or download for later listening

For Android 4.1 and up (ad-free available for purchase)

Club Logo and Call Sign Embroidering

Want your call sign or name (or both!) embroidered on your shirt, your hoodie, your duffle? Or how about a club patch with your call sign?

by Glenna Gardner, WE7SEW (glenna0354@gmail.com or text 801-592-2503)

Call sign or name = $5, Both = $8, UVARC patch = $5, Patch with call = $9

Portable Aluminum J-pole

$49, sectioned, open-stub aluminum half-wave, dual-band J-pole antenna

by Stan, KJ7BDV and Kent, N7EKF (email skantenna@yahoo.com for info or call 801-372-7260)

Complete antenna breaks down into a compact 2″ x 6″ x 12″ package weighing only 3 lbs, perfect for backpacking and portable work where you really need a good 2-meter antenna

HamBadgers

Amateur radio name badges and other products

$10, official UVARC ham radio name badge with the club logo

Visit Ham Badgers and select Ham Radio Clubs > Utah Valley Amateur Radio Club

Email Eric Palmatier at hambadgers@gmail.com or call 919-249-8704

Where everybody knows your call sign

Utah Valley Amateur Radio Club
PO Box 1288

K7UVA
Phone/Text: 801-368-1865
Email: k7uva@arrl.net

Repeaters: 146.780–, 100.0
448.200–, 100.0 224.560–, 100.0
145.250-, 100.0 448.225-, 100.0
Newsletter input?
Email uvarcshack@gmail.com
Need help?
Email uvarcelmer@gmail.com

[See all our newsletters on uvarc.club]

We are the *Utah Valley Amateur Radio Club*, a 501(c)(3) non-profit (EIN 81-360-6416) Utah corporation that was organized in an obscure Orem fire station on 02-05-2016 to provide amateur radio enthusiasts in Utah County and surrounding areas a way to gather and discuss all things ham. Our primary purposes are to provide a local amateur radio resource, help new hams in their new-found adventures, and to give more experienced hams a reason to share their wealth of knowledge and wisdom in a friendly atmosphere of fellowship. We're an ARRL Affiliate and work in cooperation with the Utah VHF Society, but are not subsidiary to them, to ARRL, ARES, or any other organization, although many of our members and leaders might also belong to the same.

This newsletter is copyrighted and published by the Utah Valley Amateur Radio Club, and its purpose is to convey the tone and temperament of the club, to inform and entertain its members, and to entice the rest. To join, go to uvarc.club/join, then sign up at www.facebook.com/groups/uvarc/ to stay informed. For more information about our club or about amateur (ham) radio in general, please email or text or call us.

More than just a club, we invite you to become part of a great ham radio movement in Utah Valley

Our fearless leadership

Presidency

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Vice President..... Chad Buttars
Secretary.....Caryn Alarcon
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James Brown, W7JHB

Club Sponsor

Heath Stevenson
Orem City Emergency Manager

From all of us to you, 73